SPECIAL OBSERVATIONS.

SOLAR AND SKY RADIATION MEASUREMENTS DURING NOVEMBER, 1919.

By HERBERT H. KIMBALL, Professor of Meteorology.

[Dated: Solar Radiation Investigations Section, Washington, Jan. 2, 1920.]

For a description of instrumental exposures, and an account of the methods of obtaining and reducing the measurements, the reader is referred to the REVIEW for January, 1919, **47**: 4.

The monthly means and departures from normal in Table 1 show that radiation measurements averaged very close to November normal values at Washington and Lincoln, and slightly above normal at Madison. Unfortunately, the records for Santa Fe, N. Mex., were lost in the mails.

Table 3 shows only slight departures from the normal radiation for November at Madison and Lincoln, and a deficiency of 5 per cent at Washington.

The skylight polarization measurements made at Washington on 8 days give a mean of 53 per cent, with a maximum of 67 per cent on the 6th. At Madison, measurements made on 5 days give a mean of 70 per cent, with a maximum of 73 per cent on the 1st. The monthly mean at Washington is below, and that at Madison is above, the November average for the respective stations. The monthly maxima are average maxima for November.

TABLE 1.—*Solar radiation intensities during November, 1919.*

[Gram-calories per minute per square centimeter of normal surface.]

Washington, D. C.

Date.	Sun's zenith distance. 0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass. 1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Nov. 3						0.72		0.64	0.60	
5			1.24	1.15	1.06	0.96	0.87	0.79	0.71	0.65
6		1.35	1.31	1.24	1.16	1.07	1.00	0.96	0.92	0.87
14			1.25	1 13	1.03	0 94	0.86	0.78	0.71	
15					0.86	0.81	0.75	0.68		
17			1.06	0.91						
18			1.23	1.07	0.98	0.91				
20			1.13	1.01	0.91	0.82	0.74			
24				1.08	1.02	0.94	0.86	0.80		
25					0.92	0.86	0.81	0.75		
Monthly means		(1.35)	1.20	1.08	0.99	0.89	0.84	0.77	0.74	(0.76)
Departure from 12-year normal		±0.00	+0.02	±0.00	−0.01	−0.03	−0.04	−0.04	−0.03	+0.05
P. M.										
Nov. 2			1.18							
6	[1] 1.42		1.26	1.20	1.14	1.08	1.01	0.95	0.89	
9			1.05	0.84						
13				1.07	0.90	0.84	0.76	0.68		
14			1.17	1.12	1.04	0.97	0.90	0.85	0.79	
15			1.00	0.99	0.82	0.77	0.70	0.61	0.55	
17					0.88	0.81	0.75			
18			1.22	1.11	1.02	0.94	0.85	0.75	0.67	0.59
20					1.01	0.94	0.82	0.70		
24					1.10	0.96	0.90	0.86	0.83	0.79
Monthly means			1.15	1.06	0.99	0.91	0.84	0.77	0.75	(0.69)
Departure from 12-year normal			−0.02	−0.02	+0.02	+0.02	+0.02	+0.01	+0.03	+0.01

[1] Extrapolated and reduced to mean solar distance.

TABLE 1.—*Solar radiation intensities during November, 1919*—Continued

Madison, Wis.

Date.	Sun's zenith distance. 0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass. 1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Nov. 1			1.38	1.25	1.14	1.07				
11							1.03	0.97	0.93	
14			1.47	1.34	1.23	1.15				
15					1.11	1.05	1.02	0.95	0.91	
18	[1] 1.47		1.38	1.32	1.26	1.18	1.14	1.08	1.03	0.99
Monthly means			1.41	1.30	1.18	1.11	1.06	1.00	0.96	(0.99)
Departure from 10-year normal			+0.10	+0.07	+0.02	−0.02	+0.03	+0.03	+0.08	+0.16
P. M.										
Nov. 1				1.28	1.20					
5					1.02					
11				1.25						
12					1.21					
14				1.35	1.28	1.18				
18				1.31	1.22	1.16				
Monthly means				1.30	1.19	(1.17)				
Departure from 10-year normal				+0.05	+0.02	+0.11				

Lincoln, Nebr.

A. M.										
Nov. 1			1.24	1.09						
3			1.37		1.20	1.12				
5				1.18	1.09					
11				1.28	1.17	1.11	1.03			
12	[1] 1.56		1.42	1.37	1.28	1.21	1.14	1.07		
13			1.37	1.25	1.15	1.06	0.97			
14			1.42	1.28						
18					1.14	1.06	0.98	0.93	0.89	
Monthly means			1.36	1.24	1.17	1.11	1.03	(1.00)	(0.89)	
Departure from 5-year normal			±0.00	−0.05	−0.05	−0.02	−0.04	−0.05	−0.09	
P. M.										
Nov. 12	[1] 1.56		1.43	1.34	1.29	1.21	1.14	1.08	1.02	0.95
13	[1] 1.49		1.33	1.27	1.18	1.09	1.02	0.95	0.89	0.84
14			1.36							
15							0.88			0.76
Monthly means			1.37	(1.30)	(1.24)	(1.15)	1.01	(1.02)	(0.96)	0.85
Departure from 5-year normal			−0.02	+0.01	+0.03	+0.02	−0.05	+0.02	+0.03	−0.05

[1] Extrapolated and reduced to mean solar distance.

TABLE 2.— *Vapor pressures at pyrheliometric stations on days when solar radiation intensities were measured.*

Washington, D. C.			Madison, Wis.			Lincoln, Nebr.		
Date.	8 a. m.	8 p. m.	Date.	8 a. m.	8 p. m.	Date.	8 a. m.	8 p. m.
1919.	*mm.*	*mm.*	1919.	*mm.*	*mm.*	1919.	*mm.*	*mm.*
Nov. 2	6.50	4.95	Nov. 1	2.87	3.15	Nov. 1	3.15	4.37
3	4.17	7.04	5	3.00	4.37	3	5.16	2.87
5	3.81	4.37	11	2.36	3.30	5	3.15	5.36
6	4.17	4.37	12	2.06	1.45	11	3.30	1.96
9	4.95	5.36	14	2.26	1.37	12	1.07	1.60
13	7.87	3.00	15	1.68	2.62	13	1.96	3.63
14	2.49	3.99	18	3.30	2.36	14	2.36	2.74
15	3.00	3.81				15	2.62	4.95
17	4.37	6.50				18	4.57	4.17
18	5.16	3.15						
20	2.87	3.63						
24	4.37	4.17						
25	3.81	8.48						

TABLE 3.—*Daily totals and departures of solar and sky radiation during November, 1919.*

[Gram-calories per square centimeter of horizontal surface.]

Day of month.	Daily totals.			Departures from normal.			Excess or deficiency since first of month.		
	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Nov. 1	77	295	334	−175	104	91	−175	104	91
2	284	211	222	34	22	−19	−141	126	72
3	234	153	261	−14	−34	22	−155	92	94
4	146	214	288	−101	29	51	−256	121	145
5	251	208	276	6	25	41	−250	146	186
6	342	36	97	100	−145	−136	−150	1	50
7	203	100	50	−36	−78	−182	−186	−77	−132
8	173	44	36	−63	−132	−194	−249	−209	−326
9	286	35	51	53	−138	−178	−196	−347	−504
10	287	164	124	57	−7	−103	−139	−354	−607
11	22	262	260	−205	94	34	−344	−260	−573
12	102	259	362	−122	93	138	−466	−167	−435
13	253	261	335	33	98	112	−433	−69	−323
14	283	252	296	66	91	75	−367	22	−248
15	257	190	289	43	31	69	−324	53	−179
16	244	151	248	33	−5	30	−291	48	−149
17	256	171	268	48	17	51	−243	65	−98
18	270	228	248	64	76	33	−179	141	−65
19	171	189	283	−32	39	69	−211	180	4
20	263	197	181	63	49	−31	−148	229	−27

TABLE 3.—*Daily totals and departures of solar and sky radiation during November, 1919*—Continued.

Day of monthe	Daily totals.			Departures from normal.			Excess of deficiency since first of month.		
	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Decade departure							−9	583	380
Nov. 21	224	31	275	27	−115	64	−121	114	37
22	63	217	245	−131	73	36	−252	187	73
23	248	185	242	56	43	34	−196	230	107
24	213	145	235	24	5	29	−172	235	136
25	147	26	58	−39	−112	−147	−211	123	−11
26	62	132	39	−122	−5	−164	−333	118	−175
27	225	155	118	44	19	−83	−289	137	−258
28	168	40	105	−11	−95	−93	−300	42	−351
29	40	32	231	−137	−102	35	−437	−60	−316
30	265	227	255	90	94	61	−347	34	−255
31									
Decade departure							−199	−195	−228
Excess or deficiency since first of year:									
Gr.-cal.							−7189	−4602	−4548
Per cent							−6.0	−4.0	−3.4

MEASUREMENTS OF THE SOLAR CONSTANT OF RADIATION AT CALAMA, CHILE.

By C. G. ABBOT, Director.

[Dated: Astrophysical Observatory, Smithsonian Institution, Washington, Dec. 22, 1919.]

In continuation of preceding publications I give in the following table the results obtained at Calama, Chile, in October, 1919, for the solar constant of radiation. The reader is referred to this REVIEW for February, August, and September, 1919, for statements of the arrangement and meaning of the table.

The observers report that the cloudiness for the month of October exceeded that for any month since the beginning of their observations in July, 1918. If they were still dependent upon the old fundamental method of observing they would have secured not over 12 days' results during the month. They have worked up additional data as a basis for applications of the new method at times when the sun is very near the zenith and hereafter many of the results will be based on observations at air masses not exceeding 1.5.

Aside from the unusually broken series of observations during the month, the most outstanding feature is the unusually low value for October 7, which is strongly supported by three independent determinations—one by the old method and two by the new. As was stated in the last report, the average value of the solar constant for the month of September was about 1 per cent below that for the month of August and apparently the depression of solar radiation reached its minimum on October 7. Solar radiation then suddenly rebounded to a value above the average for the year and continued high and even reached values unusually high during the last decade of the month.

Date.	Solar Const.	Method.	Grade.	Transmission coefficient at 0.5 micron.	Humidity.			Remarks.
					ρ/ρ_{sc}	V. P.	Rel. Hum.	
1919. October A. M.	*cal.*					*Cm.*	*P.ct.*	
2	1.944	E_0	G+	0.859	0.335	0.37	33	Cirri in east and west.
7	1.887	E_0	VG−	.839	.365	.16	15	Bank of cumuli in east. Some cirro-cumuli in west.
	1.885	M_2						
	1.912	M_2						
	1.891	W. M.						

Date.	Solar Const.	Method.	Grade.	Transmission coefficient at 0.5 micron.	Humidity.			Remarks.
					ρ/ρ_{sc}	V. P.	Rel. Hum.	
1919. October A. M.	*cal.*					*Cm.*	*P.ct.*	
8	1.954	M_3	S	.865	.462	.19	17	
	1.967	M_2						
	1.963	W. M.						
9	1.942	M_3	S	.862	.492	.18	17	
	1.951	M_2						
	1.948	W. M.						
10	1.924	E_0	VG	.865	.438	.20	19	Distant cirri in northeast.
	1.975	M_3						
	1.964	M_2						
	1.961	W. M.						
11	1.955	M_3	S	.847	.442	.23	21	
	1.950	M_2						
	1.952	W. M.						
12	1.923	M_3	U+	.824	.420	.29	27	Cirri in west.
	1.962	M_2						
	1.949	W. M.						
13	1.929	M_3	S−	.848	.502	.24	27	
	1.954	M_2						
	1.946	W. M.						
14	1.931	M_3	S	.874	.609	.16	16	
	1.950	M						
	1.940	W. M.						
15	1.979	E_0	VG+	.857	.626	.13	15	
	1.958	M_3						
	1.954	M_2						
	1.959	W. M.						
17	1.934	$M_{1.22}$	S−	.856	.700	.25	14	Cirri over most of sky.
19	1.936	M_3	S−	.860	.526	.17	18	
	1.960	M_2						
	1.955	W. M.						
20	1 952	M_3	S+	.858	.506	.18	17	Low bank of cirri in east.
	1.954	M_2						
	1.953	W. M.						
21	1.968	E_0	VG+	.851	.476	.19	19	Distant cirri in south.
	1.978	M_3						
	1,958	M_2						
	1,965	W. M.						
A. M.								
23	1.950	M_3	S	.864	.588	.19	9	Cirri scattered about sky.
	1.938	$M_{1.62}$						
	1.946	W. M.						
24	1.970	E_0	G	.832	.508	.19	19	Cirri in north and east.
	1.958	M_2						
	1.962	W. M.						
25	1.964	$M_{1.5}$	S−	.855	.600	.23	19	Scattered cirri rapidly moving east.
26	1.971	M_2	S	.846	.471	.22	26	Some thin cirri scattered about, especially in west.
	1.971	M_3						
28	1.971	W. M.						
	1.957	$M_{1.8}$	S−	.860	.689	.25	18	Cirri around east, south and west, and very thin cirri over rest of sky.
31	1.958	$M_{1.31}$	S−	.847	.735	.15	10	Cirri scattered about sky, especially in east.